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EXAMINER
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BLANCO, JAVIER G

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3738

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Please find below and/or attached an Office communication concerning this application or proceeding.



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**BEFORE THE BOARD OF PATENT APPEALS  
AND INTERFERENCES**

Application Number: 09/631,576  
Filing Date: August 4, 2000  
Appellant(s): BLAKE, LARRY

**MAILED  
JUL 05 2006  
GROUP 3700**

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Larry Blake  
For Appellant

**EXAMINER'S ANSWER**

This is in response to the appeal brief filed May 31, 2005.

**(1) *Real Party in Interest***

A statement identifying the real party in interest is contained in the brief.

**(2) *Related Appeals and Interferences***

A statement that there are no related appeals and interferences is contained in the brief.

**(3) *Status of Claims***

The statement of the status of the claims contained in the brief is correct.

**(4) *Status of Amendments After Final***

The appellant's statement of the status of amendments after final rejection contained in the brief is incorrect. No amendment after final has been filed.

**(5) *Summary of Claimed Subject Matter***

The summary of claimed subject matter contained in the brief is correct.

**(6) *Grounds of Rejection to be Reviewed on Appeal***

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct. However, and as result of the Appeal Conference of August 17, 2005, issues (A), (B), and (C) are hereby withdrawn. The only pending issue will be whether claims 40, 51-53, 56-61, 67-69, 74, 75, and 77-79 are unpatentable under 35 U.S.C. 103(a) over Lecoq (FR 2 770 394).

**(7) *Claims Appendix***

The copy of the appealed claims contained in the Appendix to the brief is correct.

**(8) *Evidence Relied Upon***

Lecoq (FR 2 770 394)

**(9) *Grounds of Rejection***

The following ground(s) of rejection are applicable to the appealed claims:

1. Claims 40, 51-53, 56-61, 67-69, 74, 75, and 77-79 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lecoq (FR 2 770 394).

With specific reference to Figures 3 and 5-13, Lecoq teaches an attachment for a two-part IOL comprising at least two cleats (anchoring tabs 24) on the optic (made of silicone or similar material) extending generally in the direction of the plane of the optic, and at least two eyelets (radial grooves 22) on the haptic (made of PMMA) allowing each of said cleats to firmly attach to one of said eyelets on the haptic. Said two-part IOL *is configured to* (emphasis added to functional language) pass completely (or separately) through a small opening ("*petite incision*") without folding the haptic, as described throughout the entire document, particularly page 5, lines 20-24.

With regards to independent claims 77 and 78, Lecoq does not particularly disclose the radial grooves 22 as "eyelets". It should be noted that slots, eyelets, apertures, or notches are consider obvious equivalents in the art, as admitted by the Applicant in the present application at page 13, lines 20-21 (see Figures 8B and 8E). Applicant's own admission is evidence that slots, eyelets, apertures, or notches are functionally equivalent, compatible, and interchangeable. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have used either slots, eyelets, apertures, or notches, as admitted by Applicant, to be attached to a cleat, since such designs are functionally equivalent, compatible, and interchangeable. One of ordinary skill in the art, furthermore, would have expected any of these designs (i.e., slot, eyelet, aperture, or notch) to perform equally well with a cleat as long as the cleat will firmly attach to the corresponding slot, eyelet, aperture, or notch, but will allow for

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easy removal of the lens (i.e., “*changer facilement de lentille*”; see page 4, lines 18-21). Also, the incision required for insertion would still be minimal (as disclosed at page 5, lines 20-24 and throughout the document).

With regards to independent claims 40 and 79, Lecoq discloses the claimed invention except for particularly disclosing the haptic rather than the optic having the cleats. It would have been obvious to one having ordinary skill in the art at the time the invention was made to have added cleats to the haptic and eyelets to the optic, since it has been held that a mere reversal of the essential working parts of a device involves only routine skill in the art. *In re Einstein*, 8 USPQ 167.

With regards to dependent claims 57 and 58, Lecoq teaches the claimed invention except for particularly disclosing KAPTON or polyphenylsulfone (PPSU) as the haptic material. It would have been obvious to a person having ordinary skill in the art at the time the invention was made to have used said materials, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability of the intended use as a matter of obvious design choice. *In re Leshin*, 125 USPQ 416.

With regards to dependent claims 59-61, Lecoq teaches the claimed invention except for particularly disclosing the modulus ranges set forth in claims 59-61. However, it would have been obvious to one having ordinary skill in the art at the time the invention was made to construct the haptic with a particular modulus (e.g., 100,000 to about 500,000 psi/inch) since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233.

**(10) Response to Argument**

a. Applicant argues that there is no suggestion in Lecoq to change the channel into an eyelet since, according to the Applicant, the attachment of Lecoq “does not perform in the way that a cleat and eyelet would”. Examiner respectfully disagrees. As previously stated (see 103(a) rejection above), slots, eyelets, apertures, or notches are consider obvious equivalents in the art, as admitted by the Applicant in the present application at page 13, lines 20-21 (see Figures 8B and 8E). One of ordinary skill in the art, furthermore, would have expected any of these designs (i.e., slot, eyelet, aperture, or notch) to perform equally well with a cleat as long as the cleat will firmly attach to the corresponding slot, eyelet, aperture, or notch, but will allow for easy removal of the lens.

b. Applicant argues that the attachment of Lecoq “renders attachment of the optic to the haptic within the eye risky”. Examiner respectfully disagrees. Lecoq clearly discloses easy removal of the lens (i.e., “*changer facilement de lentille*”) from the haptic (see page 4, lines 18-21; see entire document). Also, the attachment of Lecoq will also allow for the natural movements of the eye.

**(11) Related Proceeding(s) Appendix**

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner’s answer.

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Respectfully submitted,

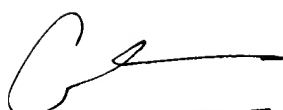
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August 18, 2005



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PTO 05-0515

CY=FR DATE=19990507 KIND=A1  
PN=2,770,394

INTRAOCULAR DEVICE COMPRISING A CARRIER FOR  
A CLEANING PAD AND A CORRECTIVE LENS  
[Dispositif intra-ocular porteur  
d'un tampon nettoyeur et d'une lentille correctrice]

Guilbert Pierre Joel Benjamin LeCoq

UNITED STATES PATENT AND TRADEMARK OFFICE  
Washington, D.C. November 2004

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INVENTOR	(72):	SAME AS APPLICANT
APPLICANT	(71):	LECOQ, GUILBERT PIERRE JOEL BENJAMIN
TITLE	(54):	INTRAOCULAR DEVICE COMPRISING A CARRIER FOR A CLEANING PAD AND A CORRECTIVE LENS
FOREIGN TITLE	(54A):	DISPOSITIF INTRA-OCULAR PORTEUR D'UN TAMPON NETTOYEUR ET D'UNE LENTILLE CORRECTRICE

The present invention concerns an intraocular device constituted by a ring designed to be placed in the capsular sac of the crystalline lens in order to serve as a carrier element to which a supported element is then fixed, its purpose being to clean the interior of this crystalline sac as well as to replace the optical power of the crystalline lens.

The cataract operation currently proceeds in the following manner:

- 1 - Short incision (in the order of 3 mm) in the limbic seat;
- 2 - Incision in the anterior capsule of the crystalline lens, along a continuous linear and circular course (capsulorhexis) with the diameter desired (between 3 and 7 mm, from 5 to 6 being the most common);
- 3 - Ablation of the contents of the crystalline lens, leaving an empty capsular sac, constituted by the posterior capsule and the remaining peripheral part of the anterior capsule, the junction of the two capsules being formed at the equator of the crystalline lens;
- 4 - Placement of a corrective lens with the adapted power in this circular capsular sac (with a diameter of about 10 mm), after possible enlargement of the limbic opening.

It is before this last item that the device according to the invention intervenes.

When it is empty, the crystalline sac is not divested of all of its contents: epithelial cells, which are going to remain coated upon the internal face of the remaining anterior capsule, and at the equator, will in many cases migrate toward the center of the posterior capsule and render it opaque. This secondary opacification (or secondary cataract) remains the great inconvenience of the present

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\* Numbers in the margin indicate pagination in the foreign text.

method, because it will then be necessary to open this posterior capsule, which runs a risk of complications, sometimes serious, and furthermore generates significant medical costs. None of the preventive solutions conceived thus far have been effective. The ideal treatment would evidently be the destruction of all these cells, but under the condition of not damaging the cells of closely neighboring structures. The solution of manual cleaning with the cannula currently remains the most accessible; but, because the periphery of the capsular is masked by the iris, it is possible to remove, under visual control, only the most centrally positioned cells or the remnant anterior capsule. (Moreover, even with the aid of endoscopy, a more extensive manual cleaning is technically very difficult).

The device according to the invention permits the hope of resolving this problem, thanks to the assembly, within the interior of the capsular sac, of a minimum of two elements: a carrier element, or support, represented by a ring that is not completely circular; and a supported element (or several elements) that completes the ring by forming a central structure, this time one that is completely circular, and which is constituted by a peripheral cleaning pad associated with a central corrective lens. This cleaning pad is adapted to the dimensions of a normal crystalline equator, and its surface is rather soft so as not to perforate the capsules (which are very thin, nevertheless rather strong, since the capsulorhexis is intact), while being sufficiently rigid and micro-traumatizing to abrade those cells coating the capsule. Once the supporting ring and cleaning pad are joined, a rotation of the unit can be easily effected by a simple manipulating hook, in one direction and then the other, alternatively,

by a series of small zones, several back-and-forth movements being carried out with regard to each, and by proceeding progressively to 360°. Thus obtained is a gentle rubbing that detaches or destroys those epithelial cells adhering to the sac. Such a device can be /2 introduced through an incision not exceeding from 3 to 4 mm. Direct visual control, under the operating microscope, is of course limited to the monitoring of that part of the anterior capsule remaining visible. But the effectiveness of the maneuvers is assured by the fact that the supporting ring occupies the equator of the capsule, which automatically positions the supported cleaning pad relative to the capsules to be cleaned.

But the method of procedure thus far was at least surprising: if this significant operating time is in some way omitted, that is to say, by leaving an extreme disorder in place, it becomes the bearer of a very negative evolution, the opacification of the posterior capsule. Once this cleaning of the sac is effected, the element carried, that is to say, the cleaning pad, is left in place if it is attached directly to the central lens. If not, it is removed and replaced in the capsular sac by a corrective lens that will be fixed to the supporting ring, which remains in place, by utilizing the same method of attachment employed for the cleaning pad.

Before beginning the detailed description of this device according to the invention, it is now possible to underline what it provides and what is the difference with existing systems or, simply described, what is the state of the art relative to the technique of cataract operations.

The supporting ring is completely different from those rings already utilized or described. It has already been proposed that a simple thin ring be introduced into the capsular sac in order to maintain the circular shape of this sac, for example in case of partial deinsertion of the zonule (which anchors the sac on the wall of the ocular globe). Likewise proposed is the utilization of a larger ring, analogous to a pneumatic tire with an internal throat designed to receive ultimately a classic lens EP 0,507,292 A1; EP 0,732,090 A1). But such a ring-tire does not include any gap and, if it is constituted by a material that is too rigid, cannot then be introduced through a reduced incision, especially through this capsulorhexis (even if an actual capacity for distention of the edge of the capsulorhexis is taken into account), without a high risk of breaking it. For these ring-tires it is therefore necessary to utilize a softer material that is pliable, but which does not have the strength or coherence needed to maintain the circular shape of the sac and to oppose the various secondary contractions responsible for later decentering. Such an inconvenience is certainly mitigated with another type of rings, no longer continuous, but in which a small opening has been made to permit the introduction of the ring more easily (FR 2,728,459 B1 and FR 9,415,645; FR 2,734,472 A1). But these rings with a slit, too rigid while remaining malleable, are designed to the entire circumference of the sac as completely as possible (in order, in particular, to create a fibrosis there for the purpose of opposing the migration of cells toward the posterior capsule), and the hiatus must be as short as possible. But a ring that is completely circular or nearly so is too long and therefore more difficult to introduce into the anterior

chamber of the eye and then into the capsular sac. The longer it is, likewise the greater the risk, at the moment of its introduction, of sweeping the exterior surfaces of the exposed eye with a potentially dangerous microbial contamination. The ring under consideration is thus too short and not completely circular, leaving a space free where the cleaning pad will rub against the equator of the sac. It is thus easier to insert, and the sweeping of the exterior can be avoided. Finally, and above all, none of those rings described thus far present a system of association with a cleaning pad.

The principle of such a cleaning has however been proposed (FR - A 2,728,459 - B1), utilizing a miniature brush, detachable or fixed, /3 seated on the external parts of the ring on either side of the miniature opening slot. But such a system, conceivable in theory, is at the limit of what can be produced, because of the extreme miniaturization required, and it does not, above all, achieve the desired objective. In fact, as described, this miniature brush would have an action that is too localized and would be inadequate. Moreover, though the goal is stated, the characteristics of this brush, its form, its modalities of attachment are by no means specified, and the specialist in the art is able to gain only a pious statement of intent, but no concrete and reproducible product. The addition of such a brush, if it is not detachable, is a permanent danger for the future due to the thinness of the capsular sac. And if, on the other hand, it is removable, it constitutes another unacceptable risk, because it is fixed to the exterior and thus very peripheral part of the ring, the result being that it would then be necessary to remove it under good visual control and withdraw the ring at least partially (which would

present a danger to the integrity of the capsular sac and the capsulorhexis). The location is in fact the peripheral zone covered at the same time by the anterior capsule and by the iris, which masks everything. Briefly stated, that solution represented here by the cleaning pad is much different.

Other differences concern, finally, the lens, which is associated initially or introduced secondarily after utilization and then ablation of the cleaning pad. The rings supporting such a lens have already been described (FR 2,728,459 - B1), but in this case the lens is asymmetrical. It comprises a principal part that completes the ring carrier on a part of its circumference and can moreover be extended peripherally up to the capsular equator, in case of association with the cleaning pad. In the description of attachments between the supporting ring and the lens carried, there can be a large gap between theory and practice in a possibly difficult operating environment in which movements are limited to a few millimeters. That device under consideration here includes a system of attachment that, to the best of applicant's knowledge, has not been described elsewhere and will be presented down to its smallest details in order to prove its practical and not merely virtual feasibility. It is expedient, before presenting it, to specify beforehand certain anatomical and operative details necessary for the comprehension of the subject.

For the limbic opening, the attempt is made to keep to a length of 3 mm, if need be, from 3.5 to 4. It has therefore been necessary to change the material for manufacturing the optics of the lens. In fact, since the beginning of implantation (1949), the material of reference is methyl polymethylmethacrylate (PMMA), which is well tolerated by the

eye. But optics produced from PMMA are rigid and cannot be deformed. It is thus recommended that the diameter of the optic not be less than 5 mm (though one as small as 4.5 mm is sometimes used), because too small a diameter runs the risk of leading to inconveniences (edge effects, dazzling at night when the pupil dilates, unwanted parasitic images, or diplopia). Therefore, to retain the benefit of a small incision, there has been recourse to an artifice consisting of the utilization of a pliable optic, that is to say, one that is flexible and not rigid, which is temporarily bent for introduction into the eye and which then resumes its circular shape, with a diameter of from 5 to 6 mm, after having been able to pass through an opening of from 3 to 4 mm. But for these materials (silicones, hydrogels, acrylics), there is less of a setback available than for the PMMA, and the fixative peripheral part of lenses produced from these materials is by other means less stable. But, in the device in question, it is likewise evidently possible to utilize a pliable lens, but there is furthermore the great advantage of also being able to accept a rigid lens made of PMMA, with a diameter of for example from 3 to 5 mm, without negative /4 secondary consequences. That, thanks to the fact that the supporting ring, which is double for the basic model, is therefore constituted by an outer loop and an inner loop, and that this internal loop can be located far inside while being larger, the diameter defined by the internal edge of this loop being for example 4 mm or less. Thus, once an optic with an analogous diameter of 4 mm is fixed to this internal loop, a satisfactory central circular unit will be formed, that is to say, one sufficiently large and avoiding the optical aberrations of edge effects, being 6 mm in the case of an optic of 4 and with an



internal slot having a width of 1 mm ( 4 + 1 + 1). With supporting and carried elements manufactured from PMMA, the junction of the lens and the internal loop will be a simple virtual gap, if the two pieces are well machined, with the tightest juxtaposition possible, as in a precision mechanical device.

In definitive form, the device in question provides new perspectives relative to the current solutions and itself achieves two objectives of differing order, providing a positive response to the apparently contradictory demands of the second of these objectives: 1 - Cleaning the capsular sac; 2 - Assuring the most complete possible occupation of the circular capsular sac, and at the same time passing through a small incision while retaining a rigid optic made of PMMA with sufficient dimensions, this material having given proof of its optical qualities and its good biological compatibility. Another advantage of this device is the possibility of easily changing the lens, without having to replace the supporting ring, for example, in order to approach emmetropia more closely or, in a temporary way, to provide better control of the retina in case of later intervention for detachment of the same.

The attached drawings illustrate, as nonlimitative examples, several modes for the embodiment of the device according to the present invention. In the drawing:

- Figure 1 is the interior view of an eye, with the outline of a short limbic incision at twelve o'clock;
- Figure 2 is a vertical sagittal section on the anterior part of the eye, showing, schematically, the situation of a classic lens in the capsular sac. Not all of the details are represented.

Reference must be made to manuals of anatomy for the description of an ocular globe. Numerals **1** and **2** refer, respectively, to the cornea and the limbus (junction between the cornea and the sclera). Numeral **3** designates the anterior chamber of the eye, **4** the iris, **5** the pupil, **6** the posterior capsule, **7** the anterior capsule, **8** the crystalline equator, **9** the capsular sac, **10** its anterior opening and **11** the zonule.

- Figure 3 represents a ring that is not completely circular, composed of two loops.
- Figure 4 is a vertical section showing the angulation between the external and internal circular loops.
- Figures 5 and 6 represent a type of the cleaning pad to be attached to this supporting ring from Fig. 3, as well as a type of lens.
- Figure 7 shows the supporting ring and cleaning pad joined.
- Figure 8 shows another type of double ring with an internal loop defining a slightly oval central space with a slightly larger diameter.
- Figure 9 shows another type of lens for the supporting ring of Fig. 8.
- Figures 10, 11 and 12 show, in sectional views, the detail of an attachment tab and the zone of the internal loop of the ring, where the cleaning pad will be attached or, later, the lens alone. /5
- Seen in Figure 13 is a lens with a diameter identical to that in Fig. 6, but with a different attachment employing two times three tabs.
- Figures 14, 15 and 16 are sections showing the detail for the

anchoring of the lens in Fig. 13, with successively: the three notches (two upper and one lower) on the supporting ring; the three attachment tabs; and the same three attachment tabs in the notches.

The device constituting the object of the invention will now be described, by considering first of all its components separately, then simultaneously. It therefore includes, for the basic model, a double ring that is not completely circular (12) with two loops, an external one (13), the other internal (14), which are concentric. They are connected together by bridges (15), which have a minimal number of two, at both ends, and which can be more numerous, with for example a third (16) midway between the others, in order to reinforce the cohesion of the ring. This ring must have, if not rigidity, at least sufficient strength as a whole in order indeed to preserve the circular shape of the sac by opposing later contractions, and it must at the same time be malleable to a degree sufficient to enable it to be introduced as easily as possible through the limbic opening, then the capsulorhexis. The orientation of these bridges can create an angulation (17) between the internal loop (14) and external loop (13): the internal loop will be more posterior and thus supported evenly against the posterior capsule, constituting a barrier generating localized fibrosis and thus opposing the proliferation of any cells remaining that have not been destroyed by the cleaning pad. Each of the two ends, where the external loop joins the internal loop, has a slightly different shape calculated so that insertion through a small limbic opening, then into the capsulorhexis, and preferably as easily as possible and at the same time. That end designed to be introduced first is more rounded (18)

and less pointed than the other (19). On the inner part of this end, which is preferred over any other part of this internal loop, a small internal projection (20) can be optionally located, being aimed radially toward the center of that circle defined in part by the internal loop and designed to occupy the space corresponding to a notch (21) possibly formed in the supporting part of the cleaning pad, as well as on the optic, if it is independent of the same, in order to facilitate introduction through an opening that is still somewhat smaller. Located on the internal loop, in two zones that are preferably diametrically opposed, are two small radial grooves (22) with edges that are not perpendicular, but slightly oblique, so that the space defined between them will have a trapezoidal shape (23). An anchoring tab (24) of the supported element, which will be locked against the supporting ring (12), will be inserted into this trapezoidal space. Also located in these two zones, or even at an equal distance between them, is a small hole (25), preferably not all the way through, or even a notch (26) on the edge of the loop, in order to facilitate the maneuvers of attaching the cleaning pad, or even the lens, to the supporting ring, as it can be seen. The ring assembly, having a perimeter sufficient to keep the sac in its circular form with the peripheral part remaining free, will be occupied by a cleaning pad (27), or possibly by a projection (28) (in the case of a separate lens), which will contribute to completing the maintenance of the circular shape of the sac.

The element carried is formed by a central part (29) for the attachment to the supporting ring and constituted by a noncorrective surface or possibly by a lens, and by peripheral part represented by

the cleaning pad (27). This central part, which is preferably circular, includes two flattened attachment tabs (24) that are diametrically opposed, with a width sufficient to assure a stable attachment without risk of anterior or posterior rocking. These two appendages could at best have a shape that is likewise trapezoidal (30) in order to engage in the two small trapezoidal receptacles (23), already described, on the internal loop (14) of the supporting ring (12). Moreover, if it is constituted by a lens, this central part presents a complementary rim (31) in that zone of free space (32) situated on either side of the ends of the internal loop, in order to constitute, when the supported element has been put into place, a perfectly circular central structure (34) (corresponding, for example, to the diameter of 6 mm) identical to this internal loop and presenting the same angulation. The peripheral part, or cleaning pad (27), has a shape somewhat similar to that of a brake block of a bicycle, that is to say, generally oblong, cylindrical, with very gradually rounded ends in order not to be traumatizing, and with a thickness in the order of from 2 to 3 mm, preferably with the dimensions of the equator of the normal crystalline lens. Just like the supporting ring, it can be produced from PMMA, a material said to be well tolerated by the eye, and which moreover exhibits a certain adhesiveness with regard to those cells with which it is in contact. (This is a serious defect, for example, for a possible contact with the cornea, but becomes the desired goal for crystalline epithelial cells).

The other element carried, in the case of a cleaning pad not initially attached to a lens, is a corrective lens having for its central part (35) the same characteristics as a lens bonded to a

cleaning pad, as described above. It comprises, however, the same complementary rim (31) in the zone of free space situated on both sides of the ends of the internal loop, so that, when the lens has been put into position, the same peripheral edge, identical to this internal loop, will thus be reconstituted. On the other hand, the peripheral part is different: reduced to the single complementary rim reconstituting a central circular structure, or even composed by a more peripheral projection (28), with a small bridge (36) connected to an external loop sector (37) having a curvature analogous to that of the external loop (13) of the supporting ring, and coming to occupy the bottom of the sac in that space left free between the two ends of this external loop.

The implantation of the device thus constituted is therefore done in several time intervals. The maneuvers are systematically carried out with visco-elastic material in the anterior chamber and in the capsular sac, which reconstitutes the volume. The ring is introduced by its large end (18) and gently pushed inside the eye with a circular movement, while the other hand maintains the other, finer end (19) still remaining outside, at a slight distance from the cornea. The larger end of the ring is best engaged directly in the capsulorhexis. (It can likewise remain in the anterior chamber and be engaged in the capsulorhexis only at a later time). At the end of the maneuver of rotation carried out, the ring is positioned definitely in place in the capsular sac. The pad (27) is then introduced. The piece is held by forceps near the edge of the central part and introduced into the anterior chamber through the limbic opening (38). It is pushed in the 6 o'clock direction, so that the cleaning pad (27) will arrive at the

level of the upper edge of the capsulorhexis. The piece is then introduced beneath the upper edge of the capsulorhexis and gently pushed, this time upward. The piece being held at all times by the forceps, an anchoring tab is engaged in the trapezoidal part (230 of the internal ring. Because this movement produces pressure against the ring in the direction of the periphery and therefore runs the risk of causing it to mask the iris, a counterpressure is exerted with a small hook introduced with the other hand (through an incision called a service incision and conventionally utilized in cataract operations). The end of this hook is therefore engaged in the small notch (26) or the orifice (25) provided near the trapezoidal groove (22) in the internal loop and exerts a force exactly compensating that corresponding to the engagement of the anchoring tab in the small trapezoid. Once this anchoring tab is in place, a transfer is made to the second one, diametrically opposite. The assembly constituting the piece still being held with the same forceps, the other anchoring tab (24) is pushed gently into the other trapezoid of the internal loop, and a counterpressure is applied with the same hook as above, in order to stabilize the assembly and to permit the introduction of the second anchoring tab. The supported piece is then locked within the interior of the internal loop, where it will fit as precisely as possible and remain stable. Secondary contractions cannot displace and remove the ring toward the exterior, since it is located at the limit of the crystalline equator, and they can no longer be displaced toward the interior due to the fact of locking the lens inside the supporting ring. The thorough cleaning of the sac interior is then carried out, as already explained. If the cleaning pad (27) is not initially /7

attached to the lens, it is then detached from the supporting ring by strictly inverse maneuvers and removed. The corrective lens (39) is then introduced and anchored in the same manner.

The protocol just described was only explanatory, other methods of proceeding being utilizable according to the variants of the device, and that without passing beyond the scope of the invention. These numerous variants concern the supporting ring, for example, the size of the free space between the two ends, the degree of angulation, the diameter of the central space defined by the internal loop. The latter can be smaller (about 3 mm) or larger (from 5 to 6 mm), with a shape that is more circular or slightly oval, but also rectangular, square, polygonal... Variants are likewise possible for the lens, its shape and dimensions being adapted to those of the central surface defined by the internal loop of the supporting ring. But these variants can also concern, above all, the cleaning pad, for example, its dimensions, which can be shorter or longer, thicker or thinner, or its surface, which can be perfectly smooth or, on the contrary, finely crenulated, or even with alternating indented and smooth zones making it more capable of applying effective abrasive action to the epithelial cells. Above all, the coating of the cleaning pad, in those of its parts in contact with the capsules, can be constituted by a sort of blotter infiltrated with a previously deposited cytotoxic product, with a concentration sufficiently active to accelerate or complete the destruction of the epithelial cells, while thus remaining localized, without risk of diffusion through the visco-elastic material and without danger to the other cells of nearby structures (cornea, iris, ciliary body). The product can also be introduced via microcatheter



connecting to the exterior of the pad, once the latter is in place. The cleaning pad can likewise be isolated, or associated with others, according to the same principle of attachment to the supporting ring. Other methods of attachment between ring and cleaning pad are likewise possible, this attachment being effected by all the traditional systems known in general for connecting two pieces together (suture, screw, /8 nut, pin, slide, socket...). But, taking into account the specifics associated with producing this attachment within a space so small as the anterior part of the eye, very close to extremely fragile structures that must absolutely not be touched (cornea), the solution expounded for the principal description, employing diametrically opposed anchoring tabs, seems to be the most practical. The number of anchoring tabs can be increased in several ways: one on one side and two on the opposite side, or even two and two, or three and two, or three and three (40), these tabs being inserted in notches (41) formed on the internal loop of the supporting ring, on its upper or lower face, in alternation, for example a lower attachment framed by two upper attachments, leading to locking that makes it possible to avoid any later displacement. To be avoided, on the other hand, are modes of attachment with the encroachment of elements of the inner loop toward the interior of the circular space that it defines, because these encroachments could be the source of parasitic images in the case of a lens of small diameter, in which case the problem would consist precisely of the elimination of these parasitic images. It is important that the fit between the edge of the lens and the inner edge of the internal loop of the supporting ring be extremely precise, resulting in a virtual slot with respective walls cut perpendicularly

or obliquely. In the same way, the internal ring can have, globally, a shape that is rather prismatic in cross section, making it possible to direct parasitic images possible toward the periphery of the retina. This edge can also be tinted or rendered opaque in order to prevent the passage of luminous rays.

The execution of the whole must strive for the greatest perfection possible on the technical level, and particularly in the choice of materials, whether it is a matter of those already utilized or those forming the object of future inventions, the fundamental condition being that they be tolerated by the eye and can be machined, in order to obtain cleaning pads that are effective and nontraumatizing, and lenses with a power defined within a range of diopters, with progression in the order of the half-diopter for confronting all needs, with the possible correction called multifocal for close-up vision and with the surface treated for better biological compatibility, etc., in which case the entire assembly is produced with maximal quality within the framework of a miniaturization corresponding to what is microsurgery for the eye.

To sum up, the present invention provides progress within the field of maintaining the transparency of the posterior capsule and that of visual correction in the case of cataract operations with small incisions. It has been described as an indication that is by no means limitative and is susceptible to diverse variants and modifications, only some of which have been considered, without passing beyond its scope.

1 - Intraocular device designed to be placed in the capsular sac of the crystalline lens while passing through a small incision, for cleaning the capsular sac and for replacing the crystalline optical power, characterized by the fact that it is constituted by a supporting element and one or more carried elements, the supporting element being constituted by a ring that is not completely circular (12), the carried element completing this ring with formation of a central structure (33), this perfectly circular part being itself constituted by a peripheral cleaning pad (27) associated with a central corrective lens.

2 - Intraocular device according to Claim 1, characterized by the fact that the supporting element constituted by the ring that is not completely circular (12) is double, being composed of loops, an external loop (13) and internal loop (13) that are concentric and joined together by bridges (15), which are at the minimum two in number at the ends of the loops and which can be more numerous, with for example a third (16) halfway between the others in order to reinforce the cohesion of the ring, the orientation of these bridges creating an angulation (17) between the external ring (13) and the more posterior internal ring (14), that assembly constituted by this not completely circular ring having a strength, as a unit, sufficient to preserve the circular shape of the sac while being sufficiently malleable to be easily inserted.

3 - Intraocular device according to Claim 1 or 2, characterized by the fact that each of the two ends of the supporting ring, where they join the external loop to the internal loop, has a different shape, the end designed to be introduced first being more rounded (18) and less

pointed than the other one (19) and presenting on its internal part, preferably at any other sector of the internal ring (14), a small internal projection (20) oriented radially toward the center of the circle in part defined by the internal loop and designed to occupy that space corresponding to a peripheral notch (21) formed in the element carried, said internal loop defining a small central space (3 mm in diameter) or larger one (5 to 6 mm), with a rather circular or slightly oval shape that can also be rectangular, square or polygonal.

4 - Intraocular device according to Claims 1, 2 or 3, characterized by the fact that two small radial grooves (22) with slightly oblique edges are located on the internal loop (14), in two diametrically opposed zones, so that the space defined between them, where an anchoring tab (24) of the carried element will be introduced, has a trapezoidal shape (23), a small hole (25) that preferably does not pass all the way through or even a notch (26) at the edge of the internal loop being likewise placed in these two zones to facilitate the attachment of the carried element.

5 - Intraocular device according to Claim 1, characterized by the fact that the carried element is formed by a central part (29) for the attachment of the supporting element and by a peripheral part, the central part, constituted by a corrective surface or even by a lens, being preferably circular and comprising two small, flat, diametrically opposed anchoring tabs (24) with a width sufficient to assure a /10 stable attachment without risk of rocking, having preferably a trapezoidal shape (30) in order to be engaged in the trapezoidal receptacles (23) of the supporting element, the peripheral part consisting itself of a cleaning pad with a shape somewhat similar to

that of a brake block of a bicycle, being generally oblong, cylindrical, with very gradually rounded ends and dimensions preferably those of the equator of the normal crystalline lens.

6 - Intraocular device according to Claim 1 or 5, characterized by the fact that the cleaning pad (27), with a smooth or one the contrary finely crenulated surface or with alternating crenulated and smooth zones isolated or associated with others according to the same principle of attachment to a supporting ring, has a coating that can be constituted by a sort of blotter infiltrated with a cytotoxic product previously deposited or introduced by a microcatheter connected to the exterior of the pad once the latter is in place.

7 - Intraocular device according to any one of the preceding claims, characterized by the fact that the supporting element represented by the peripheral cleaning pad (37) is associated with a central part (29) constituted by a lens having a shape with dimensions adapted to those of the central surface delimited by the internal loop (14) of the supporting ring, said lens presenting a rim (31) that is complementary in the zone of the free space (32) situated on either side of the ends of the internal loop, in order to constitute a central structure (33) that is perfectly circular, with a peripheral edge (34) identical to that of this internal loop and presenting the same angulation.

8 - Intraocular device according to any one of the preceding claims, characterized by the fact that the carried element, in case the cleaning pad is not initially attached to a lens, is a corrective lens having for its central part the same characteristics as a lens joined to a cleaning pad, but different ones for its peripheral part, being

reduced to a single complementary rim (31) reconstituting a circular central structure (33), or even constituted by a more peripheral appendage (28) with a bridge (36) connected to a sector of the external loop (37) and having a curvature analogous to that of the external loop (13) of the supporting ring.

9 - Intraocular device according to any one of the preceding claims, characterized by the fact that the bond between supporting element and carried element can be effected by suture, screw, nut, pin, slide, socket, and preferably by diametrically opposed anchoring tabs (24), in which case the number of anchoring tabs can be increased, these tabs being inserted in those notches (41) formed on the internal loop (14) of the supporting ring, on its upper or lower face, in alternation.

10 - Intraocular device according to any one of the preceding claims, characterized by the fact that the supporting element and carried element are manufactured from a rigid material such as PMMA, the respective walls of the edge of the lens and the internal edge of the loop being cut perpendicularly or even obliquely, their junction being a virtual slot with narrow juxtaposition.

1/2

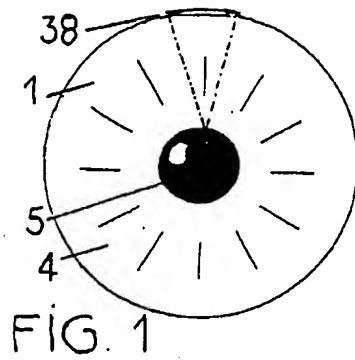


FIG. 1

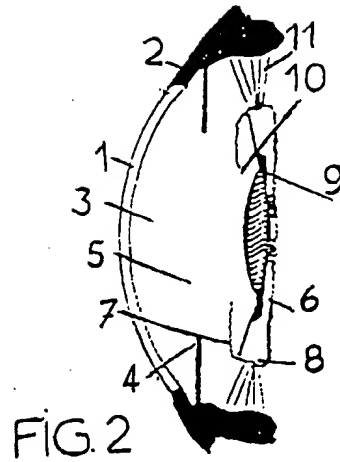


FIG. 2

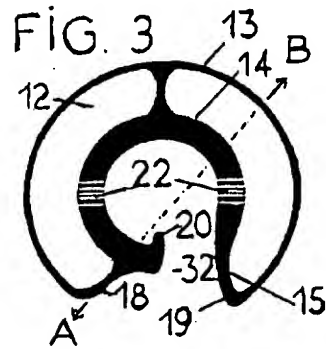


FIG. 3

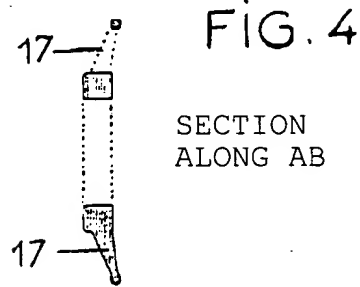


FIG. 4

SECTION  
ALONG AB

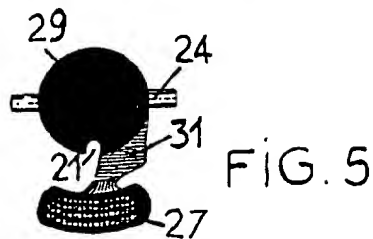


FIG. 5

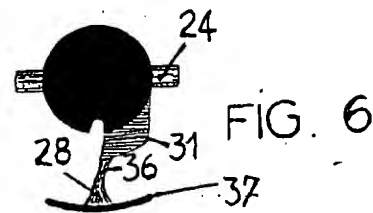


FIG. 6

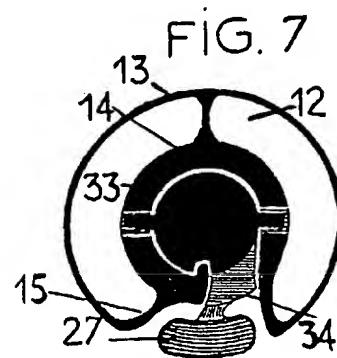


FIG. 7

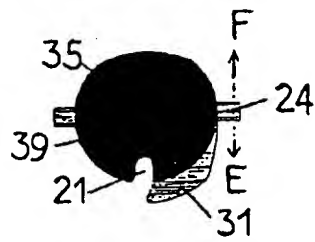
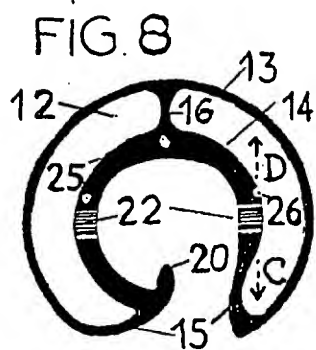


FIG. 9

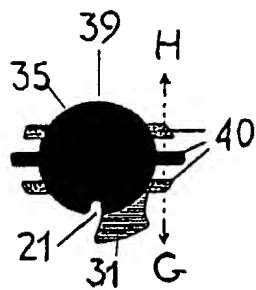


FIG. 13

SECTION ALONG CD



FIG. 10

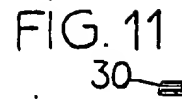


FIG. 12

SECTION ALONG EF



FIG. 14



FIG. 15

SECTION ALONG GH



FIG. 16